MSR Science Planning Group (MSPG): Progress and Preliminary Findings

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Outline

- Beginning and Progress of the NASA and ESA collaboration to accomplish Mars Sample Return
- MSPG – What is it and what has been done?
  - Findings
- Science Management of the Returned Samples

NASA-ESA Signing of SOI

"NASA and ESA intend to develop a joint MSR plan and to complete the studies needed to reach the level of technical and programmatic maturity required to pursue an effective MSR partnership, specifically defining the respective roles and responsibilities sufficient to lead to an international agreement between the two agencies in time to be submitted for approval to their respective authorities at the end of 2019."

Joint Statement of Intent between the National Aeronautics and Space Administration and the European Space Agency on Mars Sample Return

April 26, 2018

Pursuant to the highest objectives established by the international scientific community for planetary science, the National Aeronautics and Space Administration (NASA), and the European Space Agency (ESA), expressed a mutual interest in pursuing cooperation on Mars sample return activities through the signature of a 2008 Agreement addressing potential cooperation on future space exploration sample return activities that extends through December 31, 2020;

Recognizing that NASA and ESA continue sharing the common objective of together preparing and launching a set of complementary missions by the end of the next decade that would return samples from Mars to Earth for scientific research;

Recognizing that both agencies are implementing missions and conducting preparatory activities which will contribute to the realisation of a Martian sample return mission, including the NASA Mars 2020 mission that will cache samples for return to Earth and the ESA-Roscosmos Trace Gas Orbiter and ExoMars missions that will expand ESA's operational experience at Mars;

Recognizing that the 2016 ESA Council meeting at the Ministerial level mandated that ESA prepare for the next ESA Mars mission, considering European participation in an international Mars Sample Return (MSR) mission as a key objective;

Recognizing that the United States Fiscal Year 2019 President's Budget Request directs NASA to plan a potential MSR mission leveraging international and commercial partnerships; and

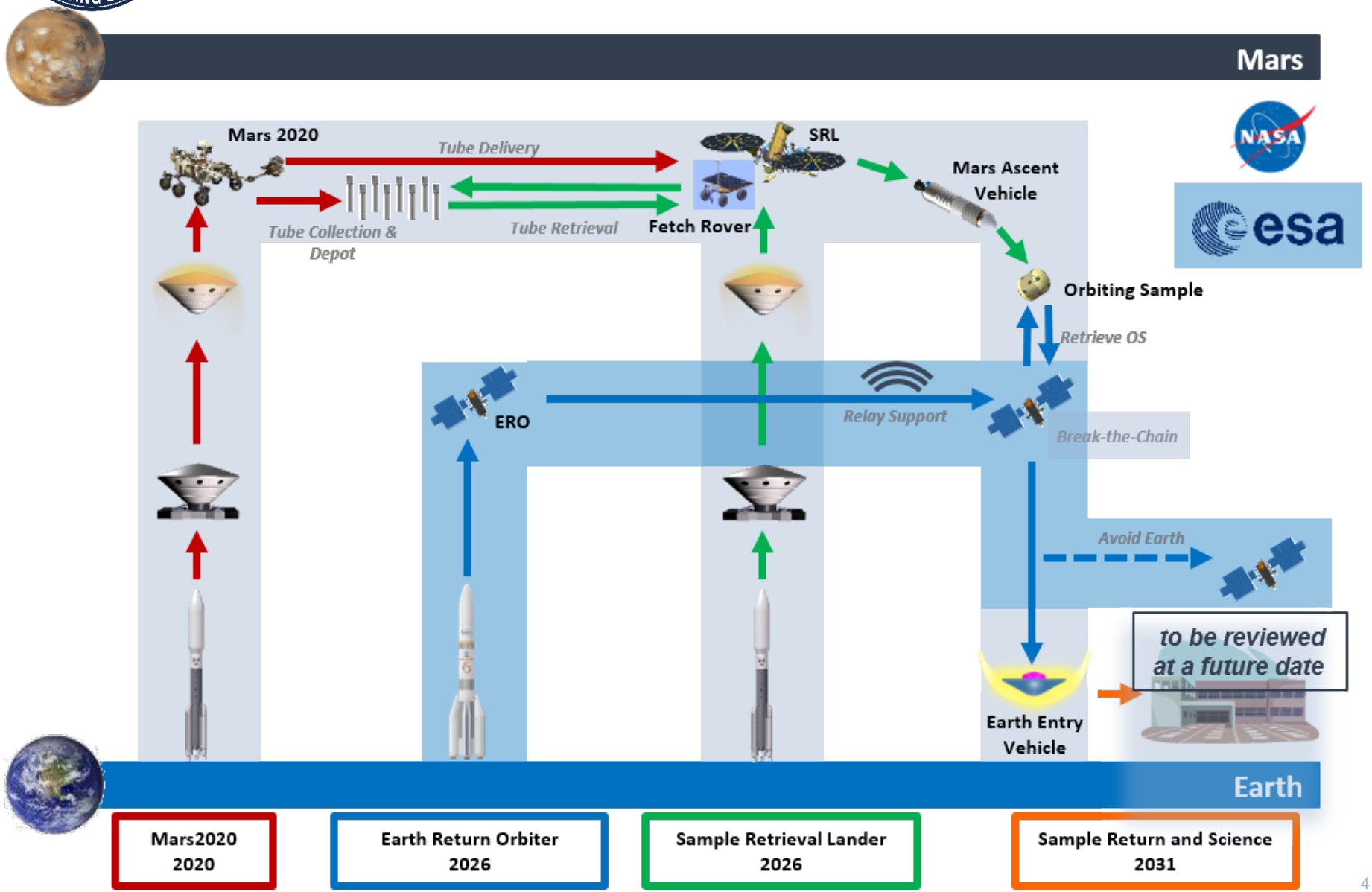
Recognizing NASA and ESA's mutual objective to collaborate on a joint MSR endeavor potentially based on a reference architecture under consideration whereby NASA would lead a MSR campaign as the systems architect and lead an MSR Lander (SRL) mission, and ESA would lead a MSR Orbiter mission and provide the Sample Fetch Rover and the Sample Transfer Arm to the SRL mission and NASA would provide the Sample Capture, Handling, and Containment system and the Earth Entry Vehicle to the MSR Orbiter; this endeavor may be in concert with other international or commercial partners;

NASA and ESA intend to develop a joint MSR plan and to complete the studies needed to reach the level of technical and programmatic maturity required to pursue an effective MSR partnership, specifically defining the respective roles and responsibilities sufficient to lead to an international agreement between the two agencies in time to be submitted for approval to their respective authorities at the end of 2019.

Thomas Zurbuchen
Associate Administrator
for Science
NASA

David Parker
Director
Human and Robotic Exploration
Programmes
ESA

Potential Mars Sample Return Campaign Overview



What is the MSR Science Planning Group (MSPG)?

MSPG established by NASA and ESA to help develop a stable foundation for international scientific cooperation for the purposes of returning and analyzing samples from Mars.

If MSR is carried out by an international partnership:

- What are the science-related attributes of a Sample Receiving Facility (SRF) that can be used as the basis for cost and schedule estimation (assume additional independent requirements will come from planetary protection)?
- What are the mechanisms whereby scientists will be given fair access to the returned samples?

A Collaboration to maximize the science return of martian samples

MSPG Workshops

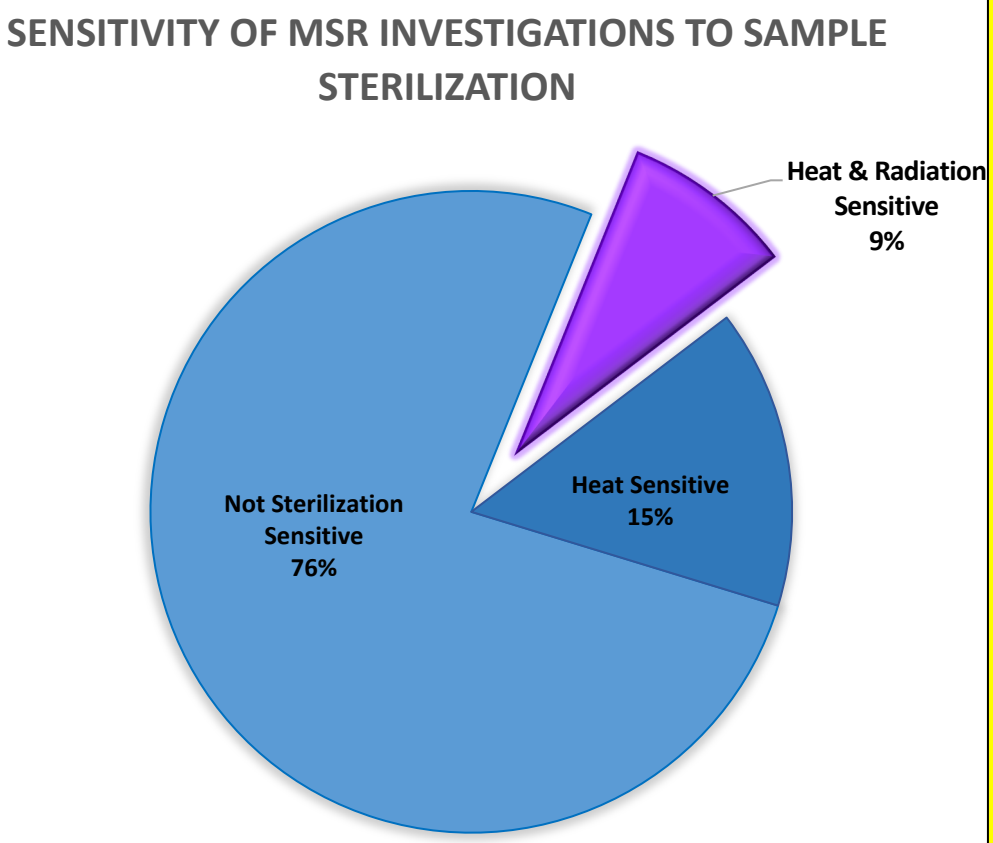
- The main science-related cost drivers for the Sample Receiving Facility (SRF) are thought to be:
  1. The challenge of conducting science activities inside high containment (BSL-4) space
  2. Contamination control
- Two workshops have been held to date:

WORKSHOP #1	***WORKSHOP #2***
To what extent does MSR science need to be done in containment?	How do the science objectives affect SRF contamination control requirements?

- In addition, a Sample Management working group is formulating options for the involvement of international scientists in different aspects of MSR.

Workshop #1-Science in Containment

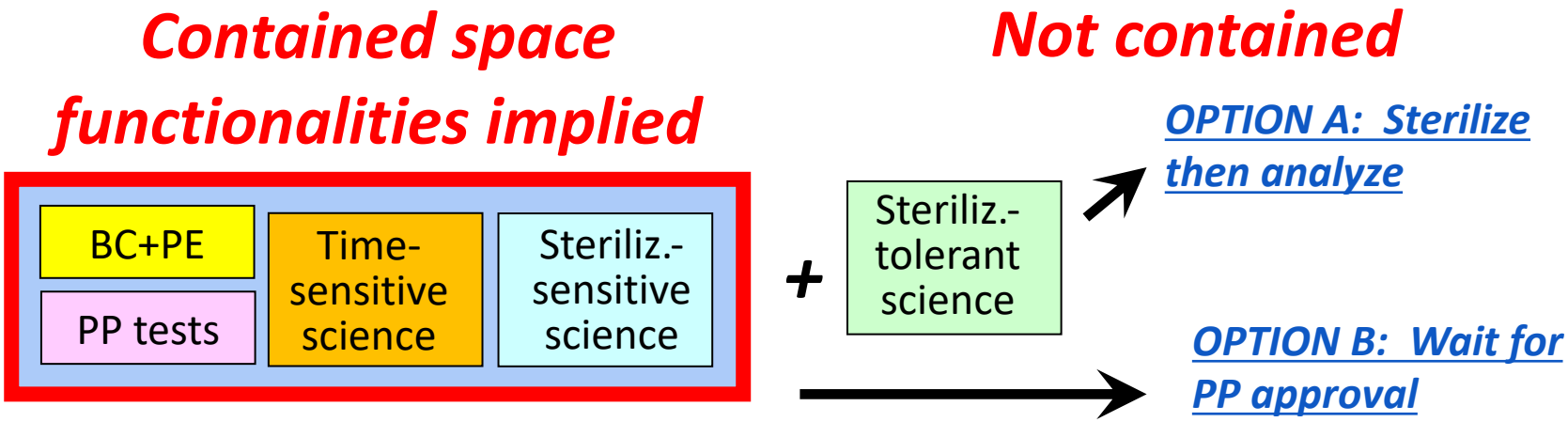
What role does contained space need to play in ensuring that all MSR scientific objectives are met?



MAJOR FINDING: It appears that a large majority (>90%) of the MSR-related science investigations, as identified by iMOST (2019), could be acceptably performed on sterilized samples, thus potentially enabling the analysis of MSR samples in uncontained laboratories without a dependency on the results from PP testing.

Workshop #1-Summary

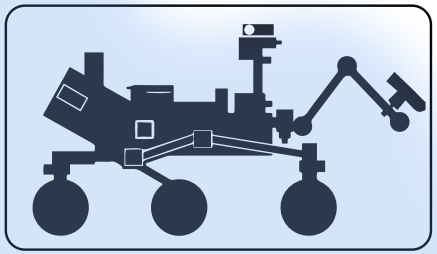
What role does contained space need to play in ensuring that all MSR scientific objectives are met?

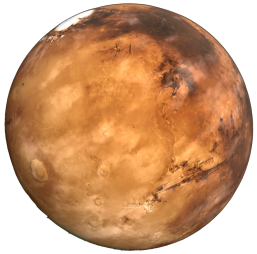


MAJOR FINDING: **The scientific community, for reasons of scientific quality, cost, timeliness, and other reasons, strongly prefers that as many sample-related investigations as possible be performed in PI-led laboratories outside of containment.**

MSR Sample Contamination—the big picture

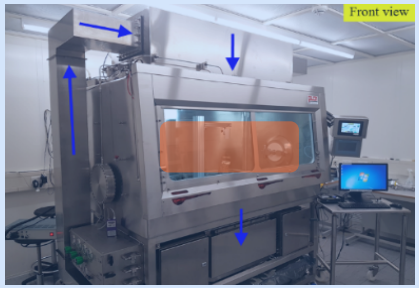
Earth-sourced contamination





Mars-sourced signal

Instruments: GC-MS etc.



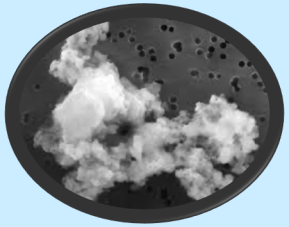
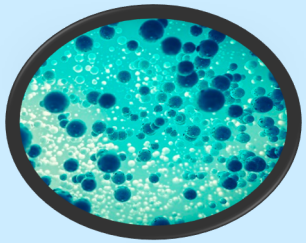
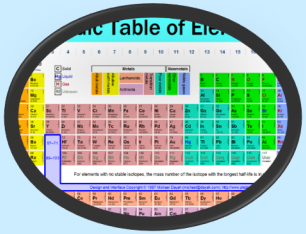
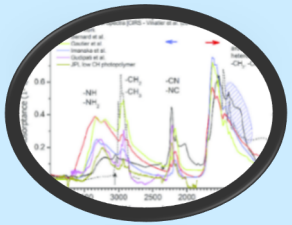
Receiving isolator

Modified after M-2020 SDT (2014)

What are our strategies to achieve MSR science objectives, given SRF-related contamination?

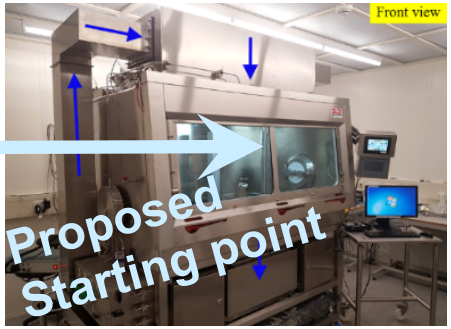
Requirements flow from M-2020 to SRF

Mars 2020 Sample-Intimate Hardware Cleanliness Requirements

Viable Organisms (<1)	Outgassing (~1 ng/cm2/hr)	Particulate (PCL 50-300)
		
		
Total Organic Carbon Tier 1 Compounds: 1 ppb Tier 2: 10 ppb TOC: 10ppb	Inorganics pg-mg levels of 34 elements	Non-volatile residue (<100 ng/cm2)

Mars sample sealed inside the sample tube

Notional sample-receiving isolation cabinet inside SRF (example only)

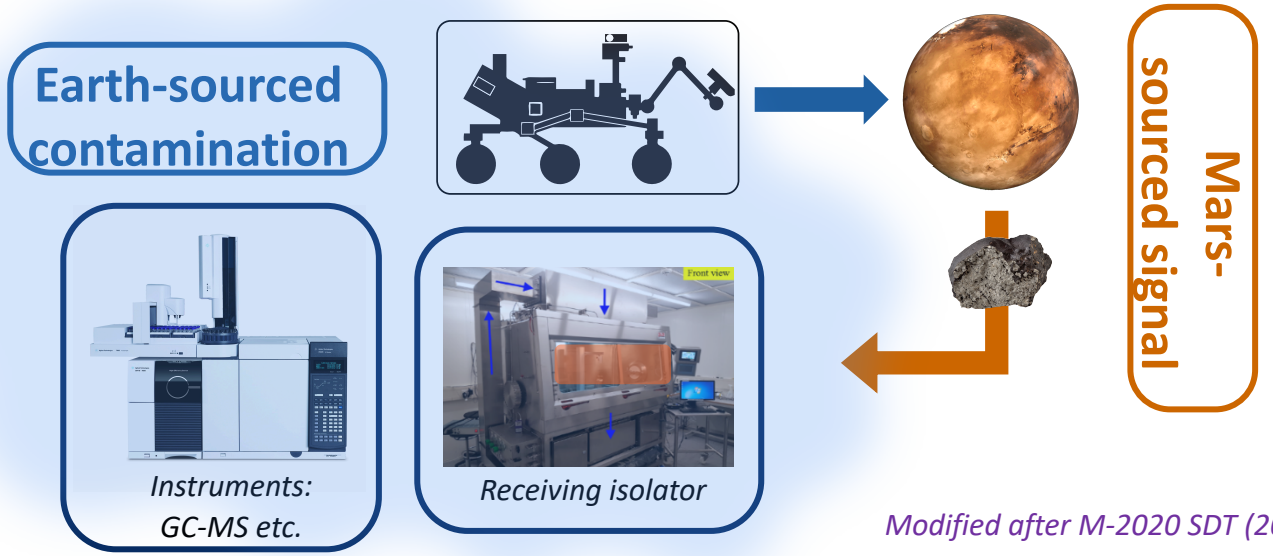


For M-2020, these requirements have been finalized

For the SRF, requirements have not yet been established. Additional reqs. may be required.

MAJOR FINDING #1: Even though the Mars 2020 Sample CC Requirements have very low values, the workshop participants were collectively not aware of reasons why these requirements could not also be implemented in isolation cabinets on Earth. This should therefore be the starting point for CC planning in the SRF and/or sample curation facilities.

Workshop #2-Summary

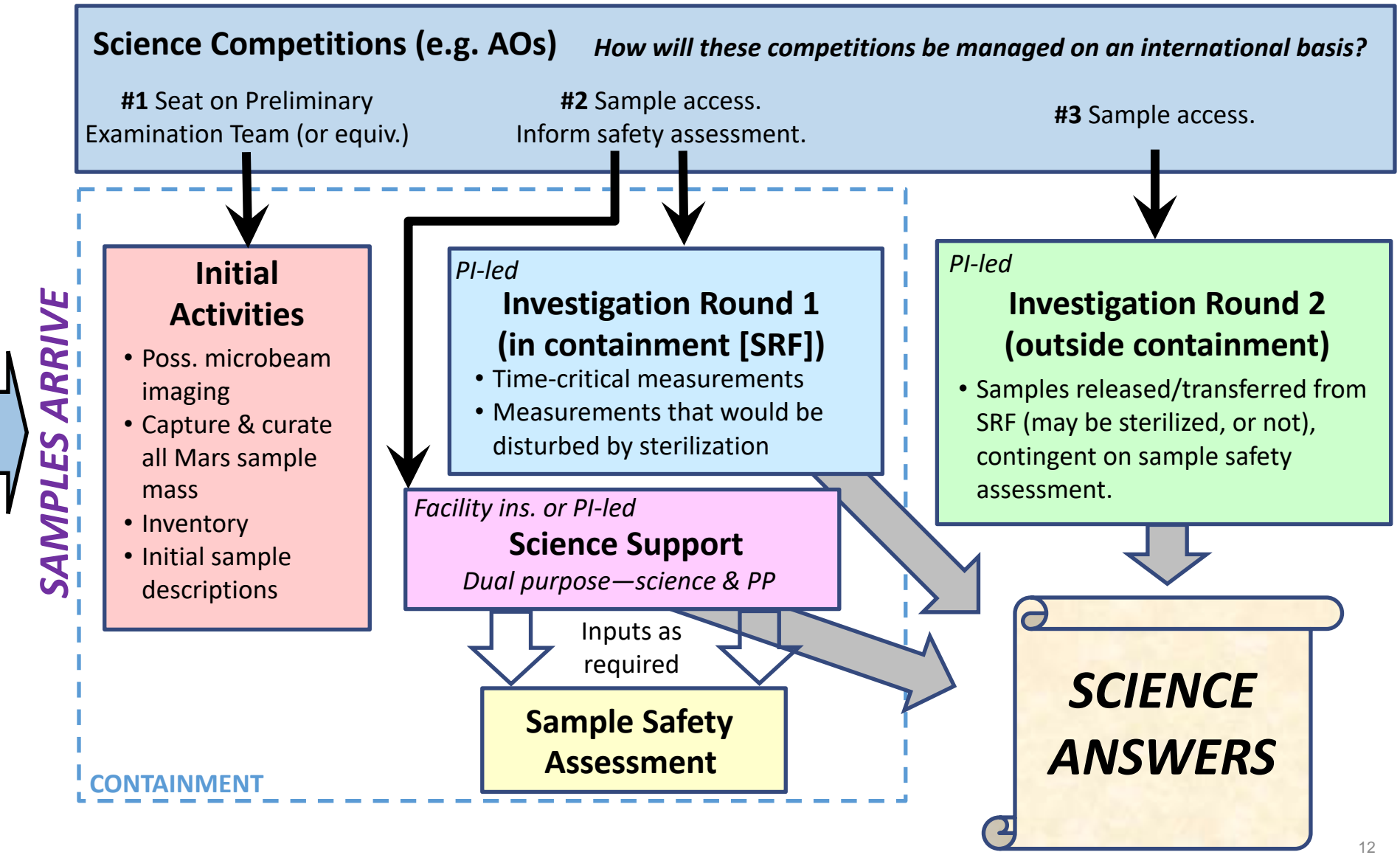


Modified after M-2020 SDT (2014)

What are our primary strategies to achieve MSR science objectives, given SRF-related contamination?

- Establish CC requirements in SRF that are as (or more) ambitious than Mars 2020 requirements
- Characterize contamination at all phases of MSR campaign and in SRF using multiple/optimized contamination knowledge (CK) strategies
- Need to plan sequence of BC and PE activities to minimize sample handling
- Characterize and curate all tools and materials used in construction of the SRF and that have been in contact with the samples

Multiple Competed Access Points for Scientists



Guiding Principles for Science Management

Science Maximization

- Access to samples must be based on the scientific benefits of the proposed investigations

Transparency

- Access to samples must be fair, open, and competed wherever possible

Accessibility

- International scientists must have multiple opportunities throughout the process to earn access to the samples

One Return Canister : One Collection

- Samples must be treated as a single collection, regardless of whether or not there is more than curation facility

Science Management Goals

Terms of Reference

MSR Science Planning Group (MSPG)

Introduction

As per the April, 2018 Statement of Intent regarding MSR, NASA and ESA are seeking to establish a partnership to return the M-2020 samples from Mars. A fundamental premise of this partnership is that scientists working in the US, Europe, and in any future partner entities, would equitably share access to the samples so that the scientific benefits and discoveries are joint. This document establishes the MSR Science Planning Group (MSPG) to develop a stable foundation for international scientific cooperation on samples returned from Mars. MSPG will accomplish this by suggesting the mechanisms through which the scientific community can share and achieve our collective goals, leading to recommendations being made to the NASA and ESA executive that will help inform programme decisions on MSR. They are community experts and agency representatives charged with convening with other members of their field, with support from partner agencies, to advise on open issues regarding MSR sample science management.

An important scientific basis for inter-agency cooperation on the science of MSR is the recent work by the International MSR Objectives and Samples Team (iMOST) on a proposed set of consensus scientific objectives for MSR. The iMOST team was sponsored by IMEWG (International Mars Exploration Working Group). Its leadership was drawn from NASA, ESA, and the U.S. and European academic communities. The Team was very large to cover an unusually wide range of scientific disciplines and internationally diverse (at least 30 scientists from each of the U.S. and Europe, along with important contributors from several other nations). As iMOST did its work, it was careful to report to the community at regular intervals, and to generate and incorporate feedback, including at the Berlin MSR conference (April, 2018), at COSPAR (July, 2018), at MetSoc (July, 2018), and at MEPAG (June, 2018). iMOST completed its final report on Aug. 1, 2018 (https://mepag.jpl.nasa.gov/reports/iMOST_Final_Report_180814.pdf). The purpose of iMOST was to update/establish consensus positions within the Mars exploration international community regarding the scientific objectives of MSR, and to analyze the specific ways in which sample studies are uniquely valuable to each objective. Although this work is believed to be the scientific basis upon which to build inter-agency planning, there are a number of additional key topics relating to handling of the samples upon return to Earth that need to be discussed and agreed for a joint plan to be submitted to stakeholders for approval.

Over the past several years, independent planning processes of relevance to MSR science, and especially planning for the Sample Receiving Facility (SRF) and curation, have been carried out in both the U.S. and in Europe. Various documents have been generated, with various embedded assumptions, that have not been shared between agencies until now. In order to establish a stable partnership between NASA and ESA, it will be necessary to revisit these assumptions, and to align the science-related functional requirements with the outcome of iMOST. This in turn should form the basis of a mutually acceptable set of implementation plans, budgets, schedules, and work processes.

Assumptions

MSPG's work is constrained by the following assumptions:

Programmatic Returns

- What 'return-on-investment' can be demonstrated to agency stakeholders?
- What are the incentives of early investment?

Science Processes

- Establish fair/transparent process for science participation
- Identify "points-of-entry" to the science community to participate in the MSR process

MSR Sample Science Timeline